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A WALL MOUNTED DOMESTIC
COMBINED HEAT AND POWER APPLIANCE

5 The present invention relates to a wall mounted
combined heat and power appliance. The invention has
been motivated by the need to improve the mounting of
a combined heat and power appliance having a linear
free piston Stirling engine. However, it can be
10 applied to any wall mounted combined heat and power
appliance where the prime mover generates undesirable
vibration.

15 The linear free piston Stirling engine operates
at a generally constant frequency and tends to vibrate
primarily in a single direction, being the direction
of reciprocation of the engine. Such vibrations can
be substantially cancelled out by suspending an
absorber mass from the engine on a spring (as
disclosed in our earlier UK application No. 0203016.1.

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Further, by suspending the engine on a number of
low-stiffness springs, transmission of any resultant
vibrations to the engine mounting can be reduced (see
our earlier application 0203016.1).

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The Stirling engine requires a seal between the
vibrating Stirling engine and an externally mounted
burner in order to prevent the burner gases from
escaping into the housing and into the dwelling.
30 Such a seal represents an interface between a
vibrating component and a static component. The seal
can be designed to be flexible in the direction of the
reciprocation of the engine, but tends to be
relatively stiff in the horizontal plane. Thus,
35 vibrations in the horizontal plane of the engine and
the absorber mass are not isolated from the appliance

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casing. The vibrations are consequently transmitted to the wall, causing the wall to vibrate, and exciting resonances in the wall and other structures. These resonances are the major cause of unacceptable vibration problems on prototype units which we have tested to date.

The present invention aims to solve this problem.

According to the present invention, a wall mounted domestic combined and power appliance comprises a prime mover to generate electrical power and heat output, a housing containing the prime mover and at least one bracket at each side of the housing to mount the housing to a wall, each bracket comprising a main body which is elongate in a vertical direction and has an L-shape section, each extremity of the L-shape cross section having an enlarged portion, a first of which provides a spacer between the main body and the housing, and a second of which provides a spacer between the main body and the wall.

This bracket arrangement has the necessary vertical rigidity to support the weight of the prime mover (and any associated absorber mass). However, the bracket also provides the necessary flexibility in the horizontal plane, both in direction towards and away from the wall (subsequently referred to as the in/out direction), and the direction parallel to the wall subsequently referred to as the left/right direction). The presence of the two enlarged portions provides sufficient clearance to allow this vibration in the horizontal plane. The brackets greatly reduce or eliminate the transference of horizontal vibrations to the wall.

A single bracket may be provided on each side of

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the housing. However, the current preference is to provide two such brackets on each side of the housing spaced in the vertical direction. More than two brackets could also be provided.

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As previously mentioned, the present invention is particularly applicable to a linear free piston Stirling engine, and particularly, to one from which an absorber mass is suspended to reduce vibrations in the vertical direction.

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With any domestic combined heat and power appliance of this type, several other connections to the outside world are required. For example, it may require a supply of combustible gas, a supply of air to a burner and an outlet for exhaust gases from the burner. In addition, to extract the heat, the unit may require an inlet for cold water and an outlet for heated water.

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The housing is, therefore, provided with flexible inlet/outlet fluid connections.

Such a connection may for example, take the form of an inlet/outlet pipe extending through an oversize hole in the housing, with a flexible seal between the hole and the pipe. Preferably, two such flexible seals are provided internal to the housing and one external to the housing respectively. The presence of at least one flexible seal ensures that the pipe is centred within the hole, prevents the pipe from making direct contact with the housing, prevents transmission of noise through the clearances and allows thermal expansion of the casing.

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The liquid pipe, in particular, can serve to transmit pressure pulses. To reduce these, each pipe

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is preferably provided with a flexible section to absorb the pressure pulses. Preferably, such flexible sections are bellows sections.

5 Examples of an appliance in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

10 Figure 1 is a schematic diagram of the connections between the appliance and the outside wall;

15 Figure 2 is a schematic perspective showing the lid of the wall mounting in brackets;

 Figure 3 is a more detailed diagram of the appliance as shown in Figure 2; and

20 Figure 4 is a cross-section through a fluid connection to the appliance.

25 The DCHP unit comprises a linear free piston Stirling engine, from which an absorber mass is suspended in order to absorb vibrations in the direction of linear motion. Such a unit is described in greater detail in our earlier application 0203016.1. The detailed construction of the engine is not of concern in the present invention.

30 The engine is mounted within a housing 1 on a frame (not shown) on a plurality of low stiffness springs (not shown) is disclosed in GB 0203016.1. This reduces the level of vertical vibration to a manageable level. However, the seal between the
35 burner and the engine head is relatively stiff, and tends to transmit vibrations in the horizontal plane from the engine head to the burner assembly and hence

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to the unit housing.

As shown in Figure 1, the engine as required to have a number of connections with the outside world. 5 Wall mounts 2 are provided to mount the engine and this will be described in greater detail with reference to Figures 2 and 3. The Stirling engine burner requires a combustible fuel inlet 3 and air intake 4. An exhaust gas outlet 5 is also required to 10 transmit the exhaust gas from the burner. In practice, the air intake 4 and the exhaust gas outlet 5 will be concentric to pre-heat incoming air.

An inlet 6 and an outlet 7 for the circulation of 15 the water to/from the domestic water heater or central heating are required.

The air intake 4 and exhaust gas outlet 5 for the burner are both connected to a recuperator which sits 20 above the Stirling engine and hence does not vibrate. Therefore this concentric arrangement simply requires a rubber concertina seal to seal to a respective housing, to ensure that the concentric flue is spaced from and generally centred within a hole within the 25 housing, so that it does not receive any vibration from the housing itself.

The fuel inlet 3 is connected to the burner housing and therefore is caused to vibrate with the 30 burner housing. For this reason, an arrangement such as that shown in Figure 4 is provided. In this arrangement, the fuel inlet 3 extends through in an oversize hole in the form of a housing formed by a short length of tube 8. The tube 8 is sealed at its 35 top and bottom end with a rubber boot 9 which holds the fuel inlet 3 away from the tube 8 and ensures that vibration of the inlet pipe is not transmitted to the

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housing. The space between the pipe 3 and tube 8 may be filled with compliant noise attenuation material.

5 The water inlet/outlets 6, 7 are also in contact with a vibrating part of the engine, and a similar arrangement is used to isolate pipes 6, 7 from the housing 1 as described above with reference to the fuel inlet 3. In addition to the features described with reference to the gas inlet, the water inlet and
10 outlet are also provided with two bellows sections 10 and which are designed to reduce pressure pulses in the liquid thereby minimising their transmission downstream.

15 Access to the housing 1 is required for maintenance purposes as indicated by arrow 11. Such access is provided by a replaceable panel with a rubber edge seal. This is designed to allow the easy, secure replacement of the panel while minimising the
20 risk of introducing leaks each time it is removed.

The wall brackets 2 are shown in greater detail in Figures 2 and 3. As shown in Figure 2, the housing 1 is supported by four brackets 2 with two brackets
25 being positioned on each side of the housing 1 and being vertically displaced from one another.

The brackets have a generally L-shape cross section shown in greater detail in Figure 3. The L-shaped cross section comprises a first side 20
30 parallel to the wall W, and a second side 21 extending away from the first side 20 perpendicular to the wall W. The first side 20 is spaced from the wall W by an enlarged portion 22 which extends from the first side
35 20 towards the wall W. Similarly, the second side 21 is spaced from the housing 1 by an enlarged portion 23 which extends from the second side 21 towards the

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housing 1.

The wall brackets are designed to give a natural frequency of 20 Hz. To ensure this, the lateral stiffness is 12,000 N/m (+/- 1000 N/m). Aluminium brackets are used, which, for the arrangement incorporating 4 brackets, are of length 225 mm and edges of 100 mm each. The material thickness is 1.5 mm. Dimensions for alternative arrangements, using different numbers of brackets, would reflect the required stiffness.

As will be appreciated from Figures 2 and 3, the brackets 2 provide adequate stiffness in the vertical direction allowing the vertical load of the Stirling engine and absorber mass to be adequately supported. However, as will be apparent from Figure 3, any vibrations in the horizontal plane are accommodated by the flexibility of the brackets 2, as well as the clearances which are provided between the sides 20 and 21 of the brackets and the housing 1 and wall 2 respectively by the enlarged portions 22 and 23.

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